How do we analyze voltage dividers in the s-domain?
How do we analyze current dividers in the s-domain?
How do we implement source transformations in the s-domain?
How do we apply s-domain analysis to circuits?
Review: Impedances with initial condition terms, Circuit transformation to the s-domain.
How do we use the transfer function to find the initial conditions for a circuit?
How do we use the transfer function to find the DC steady state as t → infinity?

Review: Correction from Class problem 13

c. $$F(s)=\frac{4s^2+12s+8}{(s+8)(s+4)^2(s+1)}$$

$$= \frac{4\cdot(s+2)\cdot(s+1)}{(s+8)\cdot(s+4)^2\cdot(s+1)} = 4\cdot\frac{(s+2)}{(s+8)\cdot(s+4)^2}$$

Zeros -2

Poles $-8, -4$double

$$F(s) = \frac{A_1}{s+8} + \frac{A_2}{s+4} + \frac{A_3}{(s+4)^2}$$

$$f(t) = A_1\cdot e^{-8t} + A_2\cdot e^{-4t} + A_3\cdot t\cdot e^{-4t}$$

Find A1 using cover up rule

$$4\cdot\frac{(s+2)\cdot(s+8)}{(s+8)\cdot(s+4)^2} = \frac{4\cdot(s+2)}{(s+4)^2}$$ at s=-8

$$A_{1c} := \frac{4\cdot(-8+2)}{(-8+4)^2}$$

$A_{1c} = -1.5$

Find A3 using the coverup rule for s+4 at s=-4

$$4\cdot\frac{(s+2)(s+4)^2}{(s+8)\cdot(s+4)^2} = \frac{4\cdot(s+2)}{(s+8)}$$

at s= -4

$$A_{3c} := \frac{4\cdot(-4+2)}{(-4+8)}$$

$A_{3c} = -2$

Find A2 using F(0) or F(1)

$$4\cdot\frac{(s+2)}{(s+8)\cdot(s+4)^2} = \frac{-1.5}{s+8} + \frac{A_2}{s+4} + \frac{-2}{(s+4)^2}$$

$F(0)$

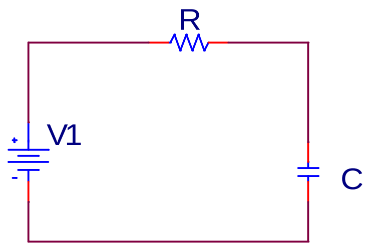
$$0.063 = \frac{-1.5}{8} + \frac{A_2}{4} + \frac{-2}{16}$$

$A_2 = 1.5$

$$f(t) = -1.5\cdot e^{-8t} + 1.5\cdot e^{-4t} - 2\cdot t\cdot e^{-4t}$$

Review

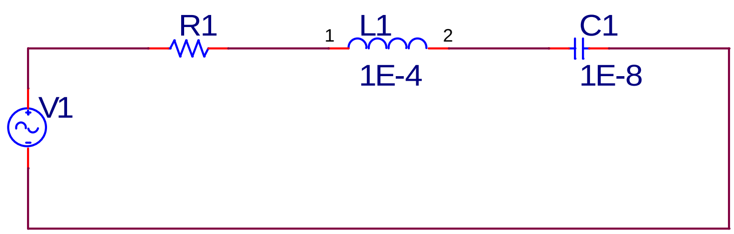
1) First Order Circuit S-domain analysis



a. Draw the s-domain equivalent circuit. V1 is an arbitrary source.
b. Symbolically, determine the transfer function for the voltage across the capacitor.
c. If the initial conditions are zero and V1 is a step function 5u(t), R = 1kΩ and C = 2E-6F, find the voltage across the capacitor.
d. If the source voltage is 10V for t < 0 and 5V for t >0, R = 1kΩ and C = 2E-6F, find the voltage across the capacitor.

2) 2nd Order S-domain analysis

RLC series circuits



In the above circuit, the voltage source turns on at t = 0, with a voltage of 10V, V1 = 10u(t) and the initial conditions are zero.

a. Draw the s-domain equivalent circuit. Include your Laplace transform of the source term. Label your component values using symbolic notation (eg. sL).

b. Using impedances, determine the transfer function for the voltage across C. Use symbolic terms in your expression (R, L, C).

c. Using your result from part b., determine the transfer function for the current through the capacitor

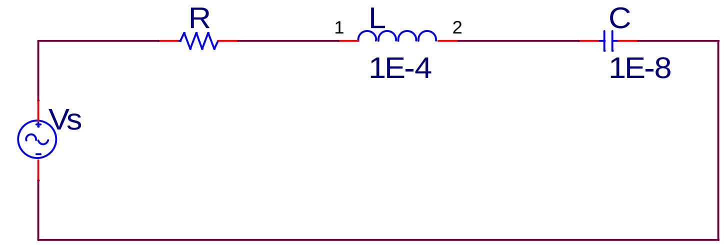
d. For R1=1000Ω, determine the voltage across the capacitor as a function of time for t > 0.

e. Team assignment!

f. For R1 = 25Ω, determine the voltage across the capactior as a function of time for t>0

3)

RLC series circuits



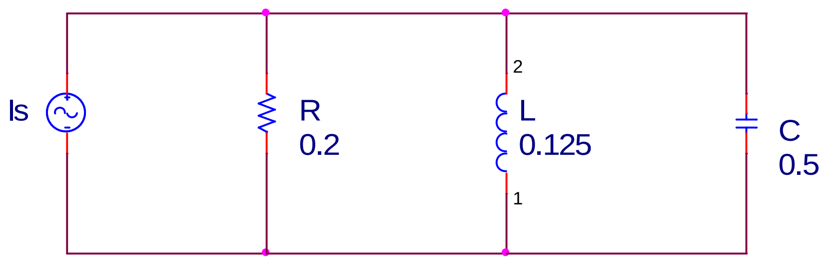
In the above circuit, the voltage source is $Vs = \begin{cases} 5V & t < 0 \\ 10V & 0 < t \end{cases}$

a. Draw the s-domain equivalent circuit. Include your Laplace transform of the source term. Label your component values using symbolic notation. Remember to include any intial value source terms.

b. Using impedances, determine the transfer function for the voltage across C. Use symbolic terms in your expression (RLC).

c. Using your result from b., determine the transfer function for the current through the capacitor. Use symbolic terms in your expression (R, L,C).

d. Using partial fraction expansion and inverse Laplace transforms, for R1 = 2000Ω, determine the voltage across the capacitor as a function of time for t>0. Verify that the intial conditions and the DC steady state conditions as t goes to infinity are satisfied.



a. Symbolically, determine the general expression for IL(s). Include initial condition terms.
b. Using s-domain analysis, determine the current through the inductor for source Is = 5u(t) mA
c. Verify using DC steady state and initial conditions